US Army Corps
of Engineers
Savannah District

SAVANNAH DISTRICT GEOSPATIAL DATA & SYSTEMS IMPLEMENTATION PLAN

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SAVANNAH DISTRICT
U.S. ARMY CORPS OF ENGINEERS

GEOSPATIAL DATA & SYSTEMS (GD&S) IMPLEMENTATION PLAN

1. Background

The U.S. Army Corps of Engineers (USACE) and its Savannah District has a long history in using a wide variety of Geospatial Data and Systems (GD&S) across many of its internal organizations. The investment in the data gathered for this purpose is great in terms of the computer hardware, software, personnel, and data collection. With the proliferation of Geographic Information System (GIS) software that is available from a number of vendors using a number of different data formats on a number of operating systems, requirements to coordinate GD&S efforts have become necessary. Database standards for GD&S are being established. Organizations within the Savannah District need to share data to reduce data acquisition and maintenance costs. A formal statement of a GD&S Implementation Plan (IP) is the first step toward a coordinated, non-redundant, efficient geospatial data collection and maintenance.

The Federal Government (Executive Order 12906) has required that all USACE Commands develop and maintain an individual GD&S Implementation Plan (IP) for purchases of dedicated GD&S hardware and software systems. Some USACE Commands have already developed and maintain implementation plans; these were used to influence the development of this document. Some of the considerations used by the Commands in developing their IPs include:

- data resolution
- format and use of presently encoded data
- anticipated needs for future data and a GD&S model
- compatibility of systems division-wide
- Information Management support needed
- coordination of GD&S needs and uses across disciplines (e.g., Real Estate, Engineering, Planning and Construction, Operations)
- cost

Development and execution of a GD&S Implementation Plan is necessary in order to guarantee the successful and effective installation of a GD&S. In order to reduce risks and minimize excessive costs and redundancy, a comprehensive design and timeline must be created in order to reduce the likelihood of failure. A three to five year timeline driven by specific performance milestones and pilot projects assures progress and manageability. Even if the full IP is not acted upon, the document will

serve as an informative report on user needs and may benefit other agencies interested in implementing a GD&S.

2. Scope

This Implementation Plan (IP) describes the past, current and anticipated uses of GD&S within the Savannah District. It outlines the needs of various organizations within the District and shows how information about the GD&S will be distributed. The Plan provides an inventory of current hardware, software and data available and a recommendation of future capital equipment purchases required for continuation of projects. All aspects of data acquisition and maintenance are addressed, including data exchange formats, ownership, access, archiving and quality. The associated with all aspects of the GD&S costs (hardware, software, data, database development, personnel and training) are discussed, along with the benefits of the system. The Mission Statements of the Division are included. The IP concludes with recommendations for GD&S implementation.

The Savannah District GD&S IP was based on extensive interviews with the various disciplines within the District that are current and potential users of geospatial data. It provides recommendations and guidance for the further implementation of geospatial data. It identifies standards related to geospatial data. This includes: requirements analysis; implementation plans; organizational issues such as staffing, training, and managerial support; system configuration and procurement of hardware, software, and telecommunications equipment; standards; data issues such as collection and acquisition, metadata (with documentation), schemas (classification), and clearinghouses (data locator and access service); applications; and evaluation criteria.

2.1 General

As defined by the National Science Foundation, a GD&S is a computerized system for the input, management, analysis, and presentation of geographically referenced data. The ultimate goal of a GD&S is to represent the reality of the world on the computer, provide the answer to real-life questions regarding the data, and allow "what if" scenarios to be modeled to avoid high costs and potential problems.

Using computers for mapping and spatial analysis has allowed great advances in data capture, data analysis, and presentation in several broadly related fields. Among these fields are cadastral and topographical mapping, thematic cartography, civil engineering, geography, mathematical studies of spatial variation, soil science, surveying and photogrammetry, rural and urban planning, utility networks, and remote sensing and image analysis. The various organizations within the Savannah District Army Corps of Engineers have needs for data and analysis in all of these areas. All these disciplines are attempting the same sort of operation: to develop a

powerful set of tools for collecting, storing, retrieving at will, transforming, importing, and displaying spatial data from the real world for a specific task.

2.2 Existing Uses

Currently, the only GD&S that is fully implemented in the Savannah District has been developed in the Spatial Engineering Section. Examples of projects that the Spatial Engineering Section have conducted include developing a graphic master plan for the Waterways Experiment Station (WES) and a base-wide GIS for Ft. Bragg, North Carolina, with all levels of infrastructure being graphically represented and the associated information available to the user with the click of a button. For Ft. Bragg, an overlay depicting no-training zones due to the existence of the Red Cockaded Woodpecker, an endangered species, was developed. Using their GIS, operators at Ft. Bragg were able to query the database for all known woodpecker habitat areas on the post and produce a "buffer zone" around them where no military training could be conducted. The GD&S was instrumental in locating the species and protecting it from further disruption.

The Spatial Engineering Section's GD&S is an Intergraph MGE/NT system that operates on the Windows/NT platform. The hardware consists of Intergraph Technical Desktop (TD) series personal workstations. The system can handle both vector and raster data, including 2-D and 3-D data. A variety of common data sources are used in the system, such as DLG and DTED, and input to the system can be from a number of common data formats, such as .DXF, .DWG, .DGN, ARC/INFO, MapInfo. Intergraph's MGE/NT accepts almost all forms of data.

The topological analysis is performed using Intergraph's MGE Analyst (MGA). This product can perform analysis on a wide range of cadastral and thematic layering, including "What If" scenarios.

Personnel from the Spatial Engineering Section have indicated that they are pleased with their current system and consider it easy to implement GD&S using Intergraph's GIS products.

The system consists of three Intergraph TD workstations (two TD-4s and one TD-3) with 1 GB hard drives, running the MGE/NT suite of GIS software, Oracle and dBase database software, TCP/IP network protocol. There are three more TDs (two TD-1s and one TD-1) with 540 MB hard drives, that serve as graphic workstations as well as providing integration with Windows/NT office automation software. These TDs all communicate over the net to the UNIX server where projects and design files are stored. This combination of UNIX and Windows/NT allows for maximum speed and maximum storage capabilities. The TDs provide the necessary processor power for large scale analysis ability. There is a DOS-based 486 PC loaded with MicroStation that serves as the system for the scanning workstation. This Black/White scanner has high resolution capability of scanning up to 800 dpi. The

Spatial Engineering Section has full raster and vector capability. See Figure 1 for a graphic representation of the system configuration.

2.3 Future Uses

This section describes the anticipated future uses of GD&S in several of the Savannah District organizations interviewed. The Operations Division and its Branches are probably the largest potential users of GD&S.

OPERATIONS DIVISION - Natural Resources Management Branch

Team Member interviewed: Mike Alexander

The current projects of the Natural Resources Management Branch include Hartwell Lake, Russell Lake and Thurmond Lake. They would like to be able to track graphically boat dock permits and dock locations on the lakes. Mike also stated that they are researching the present capabilities and future needs of staff and management, suggesting necessary hardware and sources for its acquisition, and implementation of a GIS. Some of the possible applications are:

- Examine existing Savannah District or project data for areas of interest, investigate additional data sources available, and acquire and convert such data to the ARC/INFO format

- Establish one natural resource management program, such as Navigation System, Forestry, Fisheries, or Cultural Resources, in a GIS format and develop a macro or coversheet for use by non-technical field personnel for routine management

- Assist Shoreline Management Section in using GPS units to identify locations of boat docks and coordinate data with new Shoreline Management Computer Program

- Include cultural and historical data for use in overlays and thematic mapping analysis

The Lakes (Russell, Thurmond, Hartwell) have needs which could justify self-contained offices. With the right hardware and software, support staff and training this could be a reality. Consideration has been given to training experts at the sites or training to a level necessary to only access the data. In the latter case, data files and drawings would be updated in the Savannah District Office and periodic updates furnished to each Lake Office.

Figure 1. System Configuration Diagram

With the implementation of GIS, common daily tasks could be reduced to a minimum, an example would be: "where are all the boat dock permits that expire next month?", then one could graphically display this query. Calculating shoreline acreage is a timely task, but with GIS, one could have it calculated with the click of a few on screen buttons.

ENGINEERING DIVISION - Survey & Hydrography Section, Coastal & Waterways Engineering Section

Team Member interviewed: Wade Seyle, Chief of Survey & Hydrography, Chief of Coastal & Waterways Engineering

The Survey & Hydrography and Coastal & Waterways Engineering Sections are currently not using a GD&S. Staff was interviewed regarding the kinds of GD&S uses desired in these disciplines. Some of the uses include:

- Ability to update maps from scanned photographs or drawings to develop a historical map of a river to allow more accurate theories on flood plains, building sites, river trends, etc.
- GIS boundary map production along the rivers
- Incorporation of existing maps for analysis (wetlands inventory, demographics, landuse) in future planning
- Display maneuvering permit areas for training and exercising planning
- On-screen display of survey points along the river

The Coastal & Waterways Engineering Section could produce maps in electronic format for state and local governments, who could in turn load this information on to their own GD&S systems and incorporate it into their future plans for development along the river.

PLANNING DIVISION - Budget and Information Management Unit

Team Member Interviewed: George Allwein

The Budget and Information Management Unit currently has a CADD UNIX workstation running MicroStation and IRAS/C. It is licensed for MGE and MGA UNIX version, but it has not been used. The operator has taken Intergraph training several years ago, so updated training would be necessary. George stated that some of the GD&S applications he could use the system for are:

- Military Master Planning Maps

- GPS uploading of field surveyed points and coordinates
- Resource management and planning applications for Water Resources
- Raster manipulation of scanned drawings

The Budget and Information Management Unit would like to migrate to the Windows NT platform and discontinue the UNIX version they currently have. The current operator needs updated training in order to be proficient.

REAL ESTATE DIVISION - Cadastral & Contract Section and Planning & Control Section

Team Members Interviewed: Gary Coleman, Beverly Waters

The Real Estate Division currently has a TD-3, two Northgates, MicroStation, and IRAS/C on a PC. Some of the functions and abilities they would use a GD&S for are:

- Update of scanned maps
- GIS boundary map production, property map definition
- Parcel mapping
- Survey mapping
- Cadastral and thematic mapping

Real Estate Division is responsible for maintaining the boundaries of the federal properties it oversees; they are the official keeper of properties. They acquire and dispose of properties, as well as resolve encroachments. They have a need for a true property management GIS.

EMERGENCY MANAGEMENT DIVISION - Natural Disaster Branch

Team Members interviewed: Ron Edwards, Mickey Fountain.

The Emergency Management Division plays a critical role in daily operations both during and after an emergency. To create a disaster plan, an analysis needs to be performed before so that a plan can be developed for any emergency. They also need to learn from past plans how to make corrections and predict “what if “ situations. Some of the GD&S functions they could use are:

- Storm tracking analysis
- Demographic studies
- Population statistics
- Storm surge mapping capability
- Current road maps, building locations, building footprints, etc.
- Hazardous waste sites

Emergency Management Division could benefit greatly from the analysis applications that a GD&S can offer. They can use the analysis to save lives and protect property. They can advise on building location sites and sensitive materials location analysis. They can provide critical information to the public sector in a timely manner with a fully implemented GD&S.

CONSTRUCTION DIVISION - Office Engineering Section

Team Member interviewed: Jack Cook.

Construction Division prepares findings of fact and modifications for change beyond the authority of the Resident Contracting Officer. Some of the GD&S functionality that could benefit the Construction Division are:

- PC-based software for doing contract modifications
- Installation of CADD software for better interaction with the end users and suppliers of data
- Capability to produce as-built drawings in electronic format
- Ability to do field reviewing of modification requests

The Construction Division does not currently have any GIS software. They communicate with users who supply them with drawings in paper format. These drawings must be switched to an electronic format and Construction Division must return electronic as-builts and modifications to their customers.

2.4 Needs Assessment.

The Savannah District must interface with a large number of internal and external customers with requirements for GD&S data. Because of the large number of data sources and formats, the GD&S system implemented in any Section must be an open

system in order to be successful. Coordination of the various projects using GD&S will be required, including data compatibility, data resolution, and overlapping data needs. In defining a workflow for GD&S projects in each Section the following questions should be considered:

- who is the customer (internal or external)?

- what hardware platform and software does the customer have?

- what training is required for the staff?

- can data be imported and exported with existing systems at the Savannah District?

Based on interviews within the Divisions and Sections, it is apparent that data sharing capability is a large priority. All of the Divisions and Sections interviewed had a need to share data with multiple sources. Sharing data should be a high priority for all groups. It reduces the "re-create the wheel" syndrome, and increases a project's worth, in terms of information and graphic display. Cost saving is also an issue. If the data exists and the group needing it does not have to re-create it, cost saving is obvious. You also gain knowledge in a technical sense, by increasing the communication between disciplines and outside sources, people can pick up information on file transfers, new ways of creating data, software tips, etc. Data sharing is a benefit no matter how it is approached.

2.5 Communication

A GD&S is not a static entity. For instance, changes in the status of projects, the availability of data, and information on advances in technology and software upgrades, are constantly occurring and need to be made available to participants in the GD&S. A way of sharing lessons learned on Pilot Projects should be devised to allow individuals to profit from the mistakes or "wrong paths" of others to save scarce project funds and employee time. Several ways to communicate such information are available.

The Internet is one very available and inexpensive method of acquiring information on GD&S. Almost all information on GD&S technology can be found from vendor-sponsored and topic-oriented electronic bulletin boards (GIS, Cartography Specialty Group, IGUG, etc.) Intergraph, ARC/INFO, Savannah Army Corps of Engineers, USGS, currently have publicly-available information on the Internet. They give information related to software releases, new products, where to get free software and how to solve hardware/software problems. The bulletin boards allow interaction with other individuals and organization performing similar functions and tasks and provide a forum for asking questions. In addition, product critiques are available, and information on becoming a beta test site are common.

Another excellent source of information is the World Wide Web (WWW). By using one of the many available Web Browsers (Yahoo, NetScape, Mosaic) a user can be guided to the source of many topics. It is a great place to exchange ideas and gather information with individuals who share a common work discipline. The two most popular access software vendors are Mosaic and Netscape.

Electronic mail is another way of receiving and sending information from other Government employees or from vendors who are trying to give you information on a requested topic. Electronic mail saves time and money, because less time is spent on the telephone, and may be more likely to arrive at its destination than conventional mail.

The key to all of the information described above is access to the Internet. The Savannah Army Corps of Engineers must be able to have access to the Internet at all levels if they are to stay current with the latest information. This requirement cannot be understated.

In addition, it is strongly recommendation that the Savannah District CADD users have unlimited access to the Internet. This will give each user an individual address and electronic mail capability that comes with operating software like Windows NT. It is also the recommendation of this IP that all Sections using CADD applications migrate to the TCP/IP protocol for easy access to the Internet and the capability of moving and transferring files electronically using ftp and telnet. This has been accomplished for all workstations accessing the CADD server; standalone workstations should not be considered. The use of TCP/IP and Internet access will be vital to the "Regional Village". The specifics of TCP/IP will be discussed in Section 3.1 (Hardware).

2.6 Awareness of Technology

Managers involved in decision making related to the implementation of GD&S technology need to keep up with current advancements and future directions in the field. There are several ways that this can be accomplished:

- Direct vendor contacts
- Vendor literature
- GD&S-related publications
- GD&S-related symposiums, conferences and exhibits

Vendors are often willing to demonstrate their software to a prospective client at the client's site or at the company's office, or to send appropriate literature. Although this is informative, it will focus only on the advantages of the vendors product, and perhaps on the disadvantages of competing products. Attending a non-vendor specific exhibit is a highly recommended way to compare many hardware and software products at one time. Managers can get a prospective view and

demonstration from numerous vendors, along with competitive analysis information, hardware/software costs, training information, delivery dates, etc. Information on these conferences and exhibits can be found in the Calendar of Events section of GIS trade magazines, like *GIS World*, *Geo Info Systems*, or *MicroStation Manager* (vendor-specific). These magazines are also excellent sources of information, in and of themselves. They provide articles about projects that are using the most up-to-date software and hardware, and can provide a source of new ideas of how to use the GD&S technology in new and more efficient ways. The magazines also provide the names of individuals that could be contacted if further information is required. The USACE is a regular contributor to these trade magazines. As mentioned previously, the WWW is an excellent source of information for technological advances.

3. Design Guidance

3.1 Hardware

Several industry and Government standards exist which should be used for guidance in purchasing GD&S hardware. The objectives of the standards are to: 1) reduce system costs by easing information maintenance and transfer; and 2) protect technical assets and staff time by insuring that products used by the Federal Government comply. The standards should be consulted before acquisition of hardware to assure vendor compliance. Hardware purchased via NAVFAC CAD-2 will comply.

The Savannah District currently has several different hardware systems which vary from single seat systems to a multiple seat system. For example, the Hydraulics Section, with Stan Simpson as the sole operator, operates as a single seat. In addition to the standard District system, he uses OS/2 and a Macintosh for access to the WWW and office automation. At the other extreme, the Engineering Division Design Branch operators have a 486 PC on their desk, but access and store drawings on the UNIX server in the Spatial Engineering Section. While each section operates independently, the multiple seat system allows easy data sharing, so that as-builts, modifications, or new drawings can be worked on by a number of individuals. A single seat system, while being faster for data storage and retrieval, is more vulnerable to data loss from hardware failure or unauthorized user access. The multiple user system has a central UNIX server that uses a regimented schedule of backups to assure data loss is kept to a minimum.

The speed of a multiple seat system can be increased by upgrading the network protocol. Currently, the best network today is TCP/IP. TCP/IP is already in place in the Spatial Engineering Section, but the overall District network is NOVELL. However, The NOVELL network is too slow to handle the amount of traffic that the District has. As stated in Section 2.5, it is recommended that any CADD applications implemented within the Savannah District migrate to the TCP/IP network protocol for easy access to the Internet, and for common and easy file transfer methods. It is the most accepted network on the market today.

It is recommended that the Savannah District implement a multiple system solution, with a central server to allow user access to the data. This configuration, along with proper network protocols, will give the independent user the speed of a single seat system and the security and storage capability of a multiple seat system. It will also give the user the ability to share needed data from other disciplines in a timely manner. Individual users will be able to free up disk space on their own systems and need not be concerned with daily backups of their own data because that process will be completed on the central server.

In addition to the computing hardware, peripheral hardware equipment is required to run a productive and efficient GD&S. A scanner is needed to convert hand-produced or legacy drawings into machine-usable form. A plotter is required to disseminate graphic information to people in the field or for graphic presentations. A high-speed black and white printer is needed for the production of textual information; a color printer may be required, depending on the requirements of the organization. Additional memory storage, such as an optical disk drive or jukebox, may also be required depending on the amount of data intended for the system. The above listed equipment is either currently in use or will shortly be purchased.

The Navy Facilities CAD-2 Contract provides all Government customers economical prices for the purchase of GD&S-suitable hardware. Intergraph Corporation and Cordant were awarded the contract jointly. Intergraph has placed their own computing hardware (UNIX and Windows NT) on the contract, along with various vendors for plotting and scanning equipment; Cordant offers SUN SPARCstations (UNIX) and Everex STEP (Pentium) PC hardware and various vendor's plotters and scanners. The specific hardware platform needed will depend on the system requirements. A sample listing of hardware from each contract is listed below:

	Products	**Price FY95**
CAD-2	TD2 with 17" monitor, 540 MB disk,	
	16 MB Memory	$4875
Intergraph	16 MB memory expansion	$ 600

	Products	**Price FY95**
CAD-2	Facilities CAD Desktop (Everex STEP	
Cordant	Pentium Mini Tower, 16 MB Memory	
	(expandable), 17" monitor, 540 MB disk	$4864
	16 MB memory expansion	$ 877

Both catalogs offer a variety of hardware configurations and upgrade packages, as well as maintenance prices and information on how to purchase each package.

3.2 Software

A GD&S requires software for data input, organization, manipulation, analysis, and output. A method taking information from hardcopy maps, imagery data, aerial photography or various digital formats and making it available for use is required. A database is required for logical organization and retrieval of data. Once data is in the system, it may require updating or correction, so a method of editing the data is mandatory. Plotting software is required to allow output of data so that it can be disseminated or quality checked. Finally, and most importantly to a GD&S, the data must be able to be analyzed to answer the questions of planners, engineers, management, etc. A competitive analysis of the most common GIS software packages is listed below:

Before purchasing GD&S software, it is important to have a clear understanding of the goals of the organization and the particular questions that need to be answered. Each discipline will require a slightly different group of software packages for their own branch or departmental responsibilities and tasking. It is unlikely that one software package or one software vendor will be able to satisfy the needs of all organizations. Already within the District, several different GD&S products are being used and have established loyalties.

The Navy Facilities CAD-2 Contract provides all Government customers economical prices for the purchase of GD&S-suitable software. Intergraph has placed their own software (MicroStation, MGE, MGA, VistaMap) on the contract,; Cordant offers AutoCad, ARC/INFO and ArcView software. The specific software needed will depend on the requirements of individual organizations. A sample listing of hardware from each contract is listed below:

MapInfo

Product Position: MapInfo is a desktop mapping product produced by MapInfo Corporation from Troy, New York. Versions are available for Windows, DOS, Macintosh, and UNIX. MapInfo is an easy to use, intuitive product that can import mapping data from standard PC file formats such as Excel, Lotus, dBase, .DXF, and ASCII. Commercial translators are available for importing TIGER files. It is designed for the PC user only. A 486DX/66 with 8 MB of RAM is the recommended minimum configuration. To be proficient in MapInfo, the user needs high level of technical understanding of products like Excel, Lotus, dBase, Access or Paradox.

Primary Strengths:

- MapInfo is very intuitive and is easier to use than competing products; the user will be creating maps in several hours

- Moving data from existing software and databases into the program can be done with minimal difficulty

- Geocoding and point creation are menu driven and straight forward

- The product can display several windows of different geography or regions at the same time

- MapInfo can move data between Intergraph's MGE products where other products cannot

- Inexpensive

Primary Weaknesses:

- The product does not handle large drawing files or projects and their associated data very easily

- Large numbers of drawing file levels or layers (data coverages) are cumbersome to handle

- The screen images and color output is sometime inferior to other packages

- The analysis tools are not very sophisticated

Sales Issues: MapInfo is an excellent entry-level product. While other products have greater capabilities in some areas, these are not necessarily areas the average user will need. As a user develops applications and needs more capability, the direct link to Intergraph's MGE products give the user a path of progress that other entry-level products do not have. This provides the user an opportunity to move to an enterprise-wide solution, rather than a series of single seat solutions.

Atlas GIS:

Product Position: Atlas GIS is a desktop mapping product produced by Strategic Mapping, Inc. Strategic Mapping produces several other drafting and mapping related products. Atlas GIS provides mapping and GIS analysis of data from standard PC file formats such as Excel, Lotus, dBase and ASCII. It is designed for the average PC user familiar with products like Excel, Access or Paradox and who has better than average level of technical understanding. Atlas GIS is a relatively inexpensive package that includes its own integrated database manager. It may be used on the Windows platform. The minimum system requirement is an IBM-compatible 386 PC, 8 MB RAM, Windows 3.1 or DOS 5.0, and a hard disk with 20 MB or more of free disk space. A data import module, Atlas Import, is available to

import ARC/INFO, .DXF, GBF/DIME, TIGER, ASCII, Etak, DLG, or MapInfo data. It can export ARC/INFO, .DXF, TIGER and ASCII formats.

Primary Strengths:

- Atlas GIS has an excellent screen presentation and the color output is more flexible in terms of color and shading than most other products, with the possible exception of Tactician

- The symbol library will incorporate .BMP files, which allows importation of logos, clip art, etc.

- Geographic analysis is better than most packages and includes the ability to handle up to 256 layers of data

- Advanced features, such as creating imbedded regions and multiple Standard Query Language (SQL) links are available in Atlas GIS

- Allows dynamic links to other Windows programs such as Excel for graphing

Primary Weaknesses:

- Not as easy to learn as MapInfo or ArcView

- The Windows product is a second release that does not yet match the power of the latest DOS release

- Its greater capabilities require users with higher skill levels

Sales Issues: Although Atlas GIS has more capabilities than MapInfo, it is more difficult to use. The average user will be more productive with MapInfo and require less training to be able to use the product. Atlas GIS is an excellent product for those users who do not foresee Desktop Mapping spreading across their organization or whose companies may not be interested in accommodating an enterprise-wide set of applications.

ARC/INFO 7.0

Product Position: ARC/INFO is the main GIS component from Environmental Systems Research Institute (ESRI), Inc., a nationally recognized GIS company which specializes in earth resources applications. ARC/INFO is the foundation for ESRI's GIS mapping package. It is composed of ArcEdit, ArcPlot and INFO. ArcEdit is the module which creates and modifies points, lines and polygons. It also can import and export CADD drawings from a wide range of formats. INFO is the database engine which provides the attribute information linked to the graphical components. ArcPlot

is the plotting module which performs mapping functions. Associated products include ArcCAD, a bridge software which turns AutoCad into a GIS, totally compatible with ARC/INFO. ArcView is a viewing package for ARC/INFO projects.

Primary Strengths:

- ARC/INFO is an all encompassing GIS product. It doesn't require any other modules to perform complete GIS analysis.

- ARC/INFO doesn't require separate modules to get started, the basic ARC/INFO software includes drawing (ArcEdit), database (INFO) , and mapping (ArcPlot) capabilities.

- ArcCAD provides a useful interface (and standalone GIS) through AutoCad. MicroStation can also serve as the CAD engine.

- On a smaller scale, ARC/INFO can be implemented with less training costs and start-up than MGE.

- Command-line driven which gives great control to the user. ArcTools are also available which provide an easy to use graphical user interface.

- ARC/INFO package runs on most popular UNIX platforms and uses XWindows for graphics. A PC version is available.

- ARC/INFO's data structure was built from the ground up as a topological data structure, as opposed to MGE's approach to running on top of a CADD system.

Primary Weaknesses:

- Arc is not a CADD package. Since most large scale projects require traditional CADD input work, data conversion is a very time consuming requirement. ArcCAD improves the ease and speed of import of CADD files into ARC/INFO, but it requires considerable time and effort.. The INFO database engine is archaic and cumbersome to use.

- Hard for beginners to use because mainly menu driven.

- While you can use an Oracle database, you can't use an Oracle table, you must use the INFO table.

  Sales Issues: ARC/INFO is in use at many local and state government sites, as well as utility companies and educational institutions. However, the proprietary data format makes third party software and database transparency difficult.

ArcView

Product Position: ArcView is view-only GIS/mapping product of ESRI. It is meant for individuals, such as managers, who only need to view or review geographic data, not for individuals who input or manipulate data. ArcView 2.0 is positioned as a step above MapInfo and Atlas GIS and as a serious GIS product for business and other applications. It has a direct link to ARC/INFO and the INFO database. In addition, it has its own Xbase compatible internal database and menus for SQL links to traditional corporate database products.

Primary Strengths:

- It is a 32-bit PC product
- ArcView 2.0 has possibly the best and certainly the most easily read manuals of the PC desktop mapping products
- Intuitive user interface
- The ability to use color on the screen is enhanced by a computer-generated color vamping option where the computer can select colors for the user with almost infinite possibilities
- Support for sophisticated spatial and tabular queries
- ArcView comes with the ability to customize the program easily with pull-down menus and scripts. This will allow both developers and users to create their own applications very quickly.

Primary Weaknesses:

- There is no ability to use other graphic file formats except for ARC/INFO graphics files. Data file formats are limited to .DBF, INFO and text. There is no .DXF file import.
- This product has been very long in development and ship dates have been continually pushed forward

Sales Issues: While this is a very good product, ESRI has lost a great of credibility because they did not ship ArcView 2.0 on time, upsetting their customer base.

Intergraph MGE

Product Position: MGE is a GIS mapping suite of products developed by Intergraph Corporation. MGE Basic Nucleus is the foundation for Intergraph's Modular GIS

Environment (MGE) family of mapping and GIS software products. It provides a single, constant entry point for accessing MGE project data, various GIS software routines, and other application products. Operating standalone or in a networked configuration, MGE ensures integration for GIS applications and provides common tools valuable to other MGE modules. MGE has versions that run on CLIX (UNIX) and Windows NT. Translators are available to and from TIGER, DLG, Etak, DCW, and GBF/DIME. The MGE ASCII Loader product allows translation to and from ARC/INFO.

Primary Strengths:

- Provides a common graphical user interface for MGE/NT mapping applications
- Provides project structure and organization for MGE project data
- Allows users to easily import and export project data to and from MGE between products like MapInfo and ARC/INFO
- Provides easy data migration between UNIX and PC environments
- Allows users to automate workflows based on specific user needs
- Provides many command-line interfaces for maximum user flexibility

Primary Weaknesses:

- Is not currently ported to the Sun Platform
- Its UNIX version of mapping software is proprietary to Intergraph hardware

Sales Issues: Intergraph is a Fortune 1000 company. It is also the largest vendor of mapping products based on the Windows/NT platform, with one of the most open platforms for interfacing with other competitive GIS mapping packages.

VistaMap

Product Position: VistaMap is a view-only mapping/GIS product of Intergraph Corporation. VistaMap offers data access capabilities, data analysis, and thematic mapping functions, as well as full data communication options. The software integrates multimedia and GIS, offering a low-cost multimedia viewing system. It runs on Windows 3.1 and Windows NT environments. The software requirements are Windows 3.1 or Windows NT, an MGE project database, and Relational Interface System (RIS). The hardware requirements are an Intel 386 PC or higher, 8 MB RAM, and 15 MB disk space.

Primary Strengths:

- Very easy to use
- Allows redlining for marking notations in a view
- Allows raster backdrops to vector data
- Integrates with all Microsoft office Automation tools (Word, Excel, etc.)

Primary Weaknesses:

- View only capability
- No development tools for customizing application

3.3 Data Formats

On a daily basis, the Savannah District must integrate a large number of data sources in both raster and vector format. Because of this, any conversion software that is implemented must: (1). communicate with Savannah's CADD applications and (2). communicate with the data format in question. Because there are such a large number of data sources available, it is important to choose the source carefully keeping in mind the data conversion software you have in house. See Appendix A for a listing of data formats that are currently available. Much of this data is free or for purchased for the minimal cost of data reproduction and distribution.

IMPORT/EXPORT

The most common kind of geographic data (vector) sources that the Savannah District will come in contact with will most likely be from an AutoCad graphic file (.dwg) or from a MicroStation graphic file (.dgn). The AutoCad version must be release 12 or later to read .dgn format. MicroStation 4.0 or newer will read .dxf or .dwg. Both vendors, with respect to the newer versions, can export to the other's file formats. There is a new conversion package that will translate ARC/INFO projects into MGE/NT projects with ease. This product, Arc2MGE, is put out by a third party called Redlands Software. This will be especially helpful for integrating projects between ARC/INFO and MGE/NT within the Savannah District. However, this product has not been tried with success in the Savannah District and warrants further investigation.

There are several raster data sources available today (e.g., .rle, cot, rgb, tif, .bmp). Vendor applications like Intergraph's I/RAS and ISI line of products or ESRI's ARC/INFO have the capability of reading most raster data sources. Any implementation plans should look to the future in terms of what sources of data the

project will require. The data source decision will determine the software needed for reading the raster data source.

Intergraph provides consulting services under the NAVFAC CAD-2 contract that can be used for a variety of purposes supporting hardware and software available under the contract. In particular, one service that can be provided is to support the customer on-site by writing custom code for translation of raster or vector data. Cordant and most major vendors will offer the same kind of custom services.

3.4 Connectivity

The most widely used set of communications protocols in the UNIX or Windows/NT operating system is the Internet Protocol Family, commonly know as TCP/IP. The name TCP/IP comes from two of the important protocols in the family, the Transmission Control Protocol (TCP) and the Internet Protocol (IP). The Internet Protocol Family can be used to link together computers of many different types, including PCs, minicomputers, and workstations, running different operating systems, over local area networks and wide area networks. TCP/IP was developed and first demonstrated in 1972 by the United States Department of Defense (DoD) to run on the ARPANET, a DoD wide area network. Today the ARPANET is part of the DoD Internet, and other WAN. The term Internet is commonly used to refer to both the DoD network and the protocol suite.

As stated in the hardware section of this IP, the recommended network protocol is TCP/IP. TCP/IP provides access to the Internet as well as the file transfer protocol, ftp. It also provides the telnet protocol, which allows the user to login from a remote system, or to visit another system on the network. TCP/IP also allows for transfer of binary files from UNIX to Windows/NT or vice versa.

Although transfer of data within the District for CADD applications is important, transfer of data to outside sources is even more important. The industry accepted standard for this is the TCP/IP protocol. It is the recommendation of this IP that CADD-related applications within the district migrate to the TCP/IP protocol.

4. Data Management

4.1 Data Access and Exchange

Most of the users within Savannah District are not able to communicate electronically outside of the District's building. Because of this restriction, data is received in several different forms including, 8 mm tape, CD-ROM, 3.25" floppy, 9-track tape, or reel-to-reel tape. Each Section within the District needs to be make an appropriate data exchange media a requirement when contracting with AE firms with which they will receive data.

The recommended alternative to this is to go “on-line” by giving users access to the Internet. This will allow the user to pull the data down to a computer without using an input tape drive. The data will be received quicker and will not rely on delivery by the Postal Service or overnight delivery companies. In addition, this will save money by eliminating most new hardware purchases for reading media input and output.

As soon as the 100 BASE T system is installed in the building, each CADD user will have an Internet address allowing full access to the Internet. Management should understand and be aware that although users have access to important GIS and vendor information, they also have access to desirable information which has no place in a business environment. This should be policed.

4.2 Data Exchange Formats

In addition to the data media standard, the Savannah District must establish an acceptable data format standard. There are software packages available to translate any data format currently being used in the business place today. If an AE firm wants to do business with the USACE, they must conform to USACE standards. This will eliminate costly translating and will reduce the potential for data loss.

Spatial Data Transfer Standard (SDTS) is a distributed, electronically connected network of geospatial data producers, managers, and users. It is a clearinghouse that will allow users to determine what geospatial data exist, find the data they need, evaluate the usefulness of the data for their applications, and obtain or order the data as economically as possible.

The SDTS or Federal Information Processing Standard (FIPS) Publication 173, provides solutions to the problems of transferring the full range of spatial (i.e. geographic and cartographic) data. Vector data and raster data of many different types, models, and structures, along with associated attribute data also of widely varying types, models, and structures, can be exchanged between dissimilar systems using FIPS 173. The SDTS addresses a number of levels and issues necessary to successful spatial data transfer. Among the issues covered in the standard are:

- conceptual modeling at the highest level
- definition of feature and attribute terms
- inclusion of metadata and quality reporting
- logical structuring
- details of physical encoding

The Tri-Service CADD/GIS Technology Center is currently developing geographic information system and computer-aided design and drafting (CADD) data standards for comprehensive master and environmental planning (CMEP); architecture, engineering, and construction (A/E/C); and installation facilities management (IFM).

The Tri-Service Spatial Data Standards (TSSDS) were developed as a single comprehensive master and environmental planning data model for Air Force, Army, and Navy installations, as well as USACE civil works projects. The Spatial Data Standards were designed to complement Federal Geographic Data Committee (FGDC) data standards that address small scale mapping (map scales greater than 1:24,000) with graphic and attribute data standards for entities depicted in large scale mapping (1 inch = 400 feet (1:4800) to 1 inch = 50 feet (1:600)).

Metadata provides a common set of terminology and definitions for the documentation of geospatial data. The standard establishes the names of data elements and groups of data elements to be used for these purposes, the definitions of these data elements and groups, and information about the values that are to be provided for the data elements. Information about terms that are mandatory under certain conditions, and optional (provided at the discretion of the data provided) is also provided by the standard. Metadata will be stored on a central computer which serves as a clearinghouse.

The Savannah District has reviewed the Metadata CorpsMet, the US Army of Engineers Geospatial Metadata Generator. Although the conclusion, thus far, is that the system is far too cumbersome to be useful, they have not actually tested the software for an actual project. Bob Watson at SAD has stated that the Savannah District is not alone in their concern about the time required to input data and maintain that data for each project. His position is that this would apply to in-house projects that are for the District as opposed to those for a Military Installation. Bob Watson has suggested that Savannah District actually implement the software for at least two projects and document the effort required to do so. Mr. Bill Plunkett has agreed to this test provided Engineering Division receives funding and assessment of the minimum information necessary to provide the metadata necessary for the system to be useful.

The sharing of data through the clearinghouse as described is agreed to be a good idea. For the Savannah District, it is anticipated that the costs of collecting and maintaining the data required for the Metadata standard will far exceed the usefulness of the data. A reduced set of the standard will probably suffice in the majority of cases, suiting current and future users of the data, and reducing the potentially significant costs of storing and updating the data.

4.3 Data Stewardship

In an enterprise-wide GD&S, someone must take responsibility for protecting the investment in data on several levels. First, someone at the Savannah District level must be assigned to coordinate all activities regarding the GD&S. Some of these responsibilities include: determination of minimum data quality requirements, determination of which projects are to be included in the District's system, dissemination of information about projects within the District, oversight of hardware

and software purchases for GD&S, and compliance with standards. The District level coordinator is the "landlord" of the data.

Each participating Section or Branch will also have a data "landlord". They are responsible for the same types of activities as the District level, but focus on the projects within their own group. They need to know what requirements need to be met to include their projects in the District GD&S.

At the day-to-day level in the GD&S, is the data protection stewardship role. The centralized database provides the best means possible for reduction of data loss, because proper and timely backups will be performed. On a standalone system, backup procedures are often not performed. The centralized database also provides the most up to date copy of the drawing file to any user. Data concurrency problems are eliminated by implementing a check-in/checkout software procedure on the centralized server, so that only one user can have the active copy of the drawing file at any given time; other users can have a view-only copy while the file is being updated by someone else. When the active copy is checked back in to the server, other users can have the "updated" version. This eliminates drawings from being overwritten. The data protection steward is responsible for backups of data, software upgrades to the server and any associated maintenance. It is recommended to assign a secondary person who is also knowledgeable of the server and its function to be appointed as a backup to the steward.

The software check-in/checkout capability is provided by several vendors including Intergraph and TSA-Advent. The cost for the software will be in the range of $40,000 to $80,000. Because of the wide assortment of computers, networks, etc., a study should be done to assure proper implementation. The cost of the study will be approximately $20,000. Although check-in/checkout is not mandatory, presently it will become necessary as the system grows.

4.4 Data Maintenance

In any project, data maintenance is the single most important part of the process. Without proper updates and maintenance, the data will soon become outdated and, at some point, useless. Data stewards are responsible to see that data is updated within the required timelines.

The actual data modifications and drawing maintenance should be performed by CADD/GIS operators under the supervision of the data steward. They are most familiar with the data and should be the responsible in charge of their own data updates and modifications. Software with redlining capabilities, such as MicroStation Review, are required in the GD&S software mix to allow data stewards to direct the updating/editing process. As end users become more proficient and trained, they will be able to make their own updates.

Scheduled daily, weekly and monthly backups are a requirement and should be considered a part of data maintenance. These backups are done using an 8 mm tape drive located on the server. The tapes are stored both on-site and off-site; off-site tapes ensure data security in the event of a fire or other disaster. A large capacity server is needed to handle the amount of data that Savannah District generates. The Spatial Engineering Section has an Intergraph UNIX server with 4/1 GB drives and 2/2.1 GB drives, and has plans to order two more 2.1 GB drives. Software updates to the server are done by the "steward" assigned to the server. This person is familiar with the latest software updates and knows when and how to upgrade.

4.5 Data Archiving

GD&S data consumes a great deal of space. Most workstations and servers cannot accommodate the entire legacy of data that will accumulate over years of projects. Older or less requested project data should be archived and its location documented.

There are three stages of archiving:

1. Store currently used projects on the individual workstations and backup to 3.25" floppies
2. Store projects on the UNIX file server in the Spatial Engineering Section. (This is preferred to the former)
3. Archive infrequently used projects on alternate media, such as tape or optical disk.

The UNIX file server is backed up and files are stored in a regimented schedule. Daily tape backups are performed at 11:00 PM. Weekly backups are completed every week at 11:00 PM on Fridays. Monthly backups are performed once a month at the end of each month. This gives the user, if there is any system failure or error, a method of data recovery that will minimize data loss to at most one day's work.

Data archiving is an important phase in any project. The users in the Savannah District who are not actively backing up their data are asking for a disaster. Data loss is expensive and very time consuming, doubling the project cost in most cases. The solution to this problem is the central server. If all disciplines were linked to the central server and stored their data on it, they could be assured that data loss would not interrupt or cause any additional time or costs to be added to a project. Data archiving requires a knowledgeable technical or project manager.

There is an existing Standard Operating Procedure for data archiving in the Engineering Division. Data will be archived or retrieved only with the written permission of the Technical Manager or Project Manager who is most familiar with project milestones. Users are requested to compress their files frequently to save disk

space. This procedure was established to avoid overwriting files in current use and decrease the downtime created when the server fills up.

4.6 Data Quality

On April 11, 1994, President Clinton signed Executive Order 12906 which mandates that Federal agencies document all new geospatial data sets according to the format prescribed by the Federal Geographic Data Committee (FDGC). It also requires that the documentation and data be made electronically available to the National Geospatial Data Clearinghouse. On June 8, 1994, the FGDC approved the "Content Standards for Digital Geospatial Metadata."

It is an attempt to reduce costs in the Federal government, to prevent redundant geospatial data production effort, and to create a table of contents of available Federally funded geospatial data for use by the public, as well as government agencies. It will grow, change and develop over the coming years.

The US Army Corps of Engineers Savannah District is a major player in the geospatial data arena. The Corps mission includes flood control, navigation, construction, site restoration, and emergency management, all of which require the use and creation of geospatial data. As a top Federal investor in geospatial data Savannah is significantly affected by the Executive Order. The District will be able to contribute to the NSDI initiative and will profit by use of NSDI resources.

However, as stated in Paragraph 4.2, the method of participation requires further assessment. The cost for maintaining metadata is something more than incidental as viewed by Savannah District. The costs are not currently a part of District project funds. As the pilot project determines the estimated cost in additional funding will be reserved to meet this requirement.

Savannah District has reviewed the Metadata CorpsMet, the US Army of Engineers Geospatial Metadata Generator. Although the conclusion, thus far, is that the system is far to cumbersome to be useful, they have not actually tested the software for an actual project. Bob Watson at SAD has stated that Savannah District is not alone in their concern about the time required to input data and maintain that data for each project. His position is that this would apply to in-house projects that are for the District as opposed to those for a Military Installation. Bob Watson has suggested that Savannah District actually implement the software for at least two projects and document the effort required to do so. Mr. Bill Plunkett has agreed to this test provided Engineering receives funding and assessment of the minimum information necessary to provide the metadata necessary for the system to be useful.

5. Scope of Existing and Proposed Systems

5.1 Existing Systems

Hardware:

Savannah District has been designing via CADD since the early eighties and now provides a full range of CADD services. The current CADD system which is a distributed system with software on the computer and drawing files (.dgn) residing on the central file server in the Spatial Engineering Section. The system configuration is as follows:

- two UNIX file servers with a storage capacity of 8 GB
- 6 UNIX workstations, two with 48" x 36" digitizers
- 20 workstations running the NT operating system
- 2-486DX w/16 MB of RAM, 540 MB HD and 17" monitors
- 6-Pentiums w/16 MB of RAM, 540 MB HD and 17" monitors
- 10-Pentiums w/32 MB of RAM, 1 GB HD and 20" monitors
- 2-Dual Pentiums w/16 MB of RAM, 1 GB HD and 20" monitors
- Approximately 70 workstations using the DOS 6.2 operating system. The DOS 486/DX workstations are configured with 16 megabytes of RAM and a minimum of 300 MB hard drives. Most monitors are 20", and a few are 17". In addition to the workstations, there is a full size scanner, two full size black and white electrostatic plotters, one full size plotter, a full size copier, a Docutech printer, and a combination XEROX scanner, sorter, and full and half size plotter.

Software:

The software on all CADD platforms within the District is MicroStation 5.x by Intergraph. The software is compatible on UNIX, NT, and Windows. The District is also using Intergraph's MGE software for GIS applications. The database software for GIS is Informix and Oracle. dBase IV (also used within the Spatial Engineering Section) information can be attached directly to MicroStation graphic drawings. It is also possible with Microsoft Excel, Microsoft Word and other dynamic data link software packages to post spread sheet information and word documents to drawing files. It is the recommendation of this IP that all Divisions and Sections within the Savannah District have at least one copy of MicroStation to be able to communicate with other CADD-related applications.

In order for the Savannah District to meet the requirements of its customers, they have employed a utility built into MicroStation which allows translation to AutoCad. The Savannah District has elected to use MicroStation as its graphic package of choice. MicroStation has been able to perform many of the functions AutoCad has only begun to develop with recent releases. Although the AE community uses AutoCad extensively, their demands are not as great as the Military.

The USACE has for many years used standards for MicroStation CADD design which makes transfer and reuse easy. No standards for level control, color, line weight., etc. have been established for AutoCad, so it is very confusing when receiving work from different sources. Standards from the Waterways Experiment Station (WES) have been due out for over a year, and when these standards are released, they will assist the end user in the development of a standard database for GIS projects. This standard defines graphic symbology as well as graphic feature attributes. Because the standard is very large, some customization can be expected when implementing the standard from WES.

MicroStation can work from multiple platforms, such as VMS, UNIX, DOS, OS/2, and NT. Files are compatible from one platform to the next and files created using the latest version can be set up to be compatible with the earliest. AutoCad started as a DOS software package and has not successfully addressed other platforms.

5.2 Pilot Projects

As a proof of concept to show the feasibility of a District-wide GD&S, it is proposed to implement a pilot project involving as many groups (Divisions, Branches, Sections) as feasible within the Savannah District. A limited geographic area of a commonly utilized set of spatial data such as roads would be ideal. However, it may require several geographic areas to fully test the system. Specific data needs for as many as groups as possible will be integrated into this project. For example, Hazardous Toxic Radioactive Waste (HTRW) Section would like to be able to locate waste sites within a geographic area. Survey group would like to find geodetic monuments also within this area. Real Estate Division may have the common goal of finding parcel boundaries within certain geographic bounds.

A very limited in size, but detailed in scope GD&S project should be implemented to demonstrate the benefit of shared, commonly formatted geospatial data. Funding for this project could come out of District overhead, and/or be partially financed by the individual groups wishing to participate in it.

It is recommended that a maximum of 6 months be expended from start to finish for the pilot project.

Each group that participates in the pilot project will have different mission tasks, and thus, will have varying data needs. Some of the data needed will be common to one or more groups, however, there will be varying scale and accuracy requirements depending on the task. For example, some groups may need a map at 1:100,000 scale, while others map need the same area of geographic interest at 1:25,000. In this case, the common scale of 1:25,000 will satisfy the data needs of both requirements. While no one site will be useful to every group, to the extent possible, a common area or areas of geographic interest will be used.

The goals of the pilot project are two-fold:

1. to demonstrate the feasibility and benefits of GD&S implementation with a certain group.

2. to demonstrate the efficiency and economy of scale of shared data resources.

The effort required by each group to implement the pilot project will be:

- task knowledgeable point of contact within the group
- detailed identification of mission and work flow
- data accuracy and precision requirements
- supply of actual data needed to accomplish the mission task within the chosen pilot project area

5.3 Proposed Systems

OPERATIONS DIVISION:

Regulatory Branch.

Hardware: One (1) TDZ40 High-end Workstation 133 MHz Dual Pentium processor. 32 MB of memory (expandable to 256 MB) and a 3.5-inch, 1 GB disk drive on a dual SCSI interface. An internal 5.25-inch, 600 MB, double speed CD-ROM drive, and 3.5-inch floppy disk drive, a three button mouse, and a personal workstation keyboard. **Cost $13,442.00**. One (1) 21-inch, 1.2 megapixel (1600x1200) color monitor. **Cost $1,763.00**

Software: One (1) copy of I/Basic Mapping for Windows/NT, which includes the following products: MGE/SX for Windows/NT, MGE Analyst, MGE Finisher, and MGE Projection Manager. **Cost $4,608.00**

Total package cost $ 19,813.00

Natural Resources Branch (Russell, Thurmond, Hartwell)

Hardware: A SPARCstation 5 with 85 MHz MicroSPARC processor, 24 KB of cache, 32 MB of RAM, two (2) 535 MB hard drives, TurboGX graphics processor, 20-inch color monitor, 1.44 MB floppy, Tektronix emulator. **Cost $ 9,320.00**

Software: ARC/INFO Basic Mapping. **Cost $ 3,888.00**

Total package cost $ 13,208.00

ENGINEERING DIVISION:

Survey and Coastal Branch

Hardware: One (1) TDZ40 High-end Workstation 133 MHz Dual Pentium processor. 32 MB of memory (expandable to 256 MB) and a 3.5-inch, 1 GB disk drive on a dual SCSI interface. An internal 5.25-inch, 600 MB, double speed CD-ROM drive, and 3.5-inch floppy disk drive, a three button mouse, and a personal workstation keyboard. **Cost $13,442.00**. One (1) 21-inch, 1.2 megapixel (1600x1200) color monitor. **Cost $1,763.00**

Software: One (1) copy of I/Basic Mapping for Windows/NT, which includes the following products: MGE/SX for Windows/NT, MGE Analyst, MGE Finisher, and MGE Projection Manager. **Cost $4,608.00** One (1) copy MGE Terrain Modeler, **Cost $ 1,123.00**

Total package cost $ 20,936.00

Site and Civil Branch

Hardware: One (1) TDZ40 High-end Workstation 133 MHz Dual Pentium processor. 32 MB of memory (expandable to 256 MB) and a 3.5-inch, 1 GB disk drive on a dual SCSI interface. An internal 5.25-inch, 600 MB, double speed CD-ROM drive, and 3.5-inch floppy disk drive, a three button mouse, and a personal workstation keyboard. **Cost $13,442.00**. One (1) 21-inch, 1.2 megapixel (1600x1200) color monitor. **Cost $1,763.00**

Software: One (1) copy of I/Basic Mapping for Windows/NT, which includes the following products: MGE/SX for Windows/NT, MGE Analyst, MGE Finisher, and MGE Projection Manager. **Cost $4,608.00** One (1) copy MGE Terrain Modeler, **Cost $ 1,123.00** One (1) copy of MGE Base Imager, **Cost $ 1,435.00**

Total package cost $ 22,371.00

Geotech Branch

Hardware: One (1) TDZ40 High-end Workstation 133 MHz Pentium processor. 32 MB of memory (expandable to 256 MB) and a 3.5-inch, 1 GB disk drive on a dual SCSI interface. An internal 5.25-inch, 600 MB, double speed CD-ROM drive, and 3.5-inch floppy disk drive, a three button mouse, and a personal workstation keyboard. **Cost $13,442.00**. One (1) 21-inch, 1.2 megapixel (1600x1200) color monitor. **Cost $1,763.00**

Software: One (1) copy of I/Basic Mapping for Windows/NT, which includes the following products: MGE/SX for Windows/NT, MGE Analyst, MGE Finisher, and MGE Projection Manager. **Cost $4,608.00** One (1) copy MGE Terrain Modeler, **Cost $ 1,123.00** One (1) copy of MGE Base Imager, **Cost $ 1,435.00**

Total package cost $ 22,371.00

Hydraulics

Hardware: A SPARCstation 5 with 85 MHz MicroSPARC processor, 24 KB of cache, 32 MB of RAM, two (2) 535 MB hard drives, TurboGX graphics processor, 20-inch color monitor, 1.44 MB floppy, Tektronix emulator. **Cost $ 9,320.00**

Software: ARC/INFO Basic Mapping. **Cost $ 3,888.00**

Total package cost $ 13,208.00

PLANNING DIVISION:

Budget & Information Management

Hardware: One (1) TDZ40 High-end Workstation 133 MHz Dual Pentium processor.
32 MB of memory (expandable to 256 MB) and a 3.5-inch, 1 GB disk drive on a dual SCSI interface. An internal 5.25-inch, 600 MB, double speed CD-ROM drive, and 3.5-inch floppy disk drive, a three button mouse, and a personal workstation keyboard. **Cost $13,442.00**. One (1) 21-inch, 1.2 megapixel (1600x1200) color monitor. **Cost $1,763.00**

Software: One (1) copy of I/Basic Mapping for Windows/NT, which includes the following products: MGE/SX for Windows/NT, MGE Analyst, MGE Finisher, and MGE Projection Manager. **Cost $4,608.00,** One (1) copy of MGE Base Imager, **Cost $ 1,435.00**

Total package cost $ 21,248.00

REAL ESTATE DIVISION:

Hardware: One (1) TDZ40 High-end Workstation 133 MHz Dual Pentium processor. 32 MB of memory (expandable to 256 MB) and a 3.5-inch, 1 GB disk drive on a dual SCSI interface. An internal 5.25-inch, 600 MB, double speed CD-ROM drive, and 3.5-inch floppy disk drive, a three button mouse, and a personal workstation keyboard. **Cost $13,442.00**. One (1) 21-inch, 1.2 megapixel (1600x1200) color monitor. **Cost $1,763.00**

Software: One (1) copy of I/Basic Mapping for Windows/NT, which includes the following products: MGE/SX for Windows/NT, MGE Analyst, MGE Finisher, and MGE Projection Manager. **Cost $4,608.00** One (1) copy MGE Terrain Modeler, **Cost $ 1,123.00** One (1) copy of MGE Base Imager, **Cost $ 1,435.00**

Total package cost $ 22,371.00

EMERGENCY MANAGEMENT:

Hardware: One (1) TDZ40 High-end Workstation 133 MHz Pentium processor. 32 MB of memory (expandable to 256 MB) and a 3.5-inch, 1 GB disk drive on a dual SCSI interface. An internal 5.25-inch, 600 MB, double speed CD-ROM drive, and 3.5-inch floppy disk drive, a three button mouse, and a personal workstation keyboard. **Cost $13,442.00**. One (1) 21-inch, 1.2 megapixel (1600x1200) color monitor. **Cost $1,763.00**

Software: One (1) copy of I/Basic Mapping for Windows/NT, which includes the following products: MGE/SX for Windows/NT, MGE Analyst, MGE Finisher, and MGE Projection Manager. **Cost $4,608.00** One (1) copy MGE Terrain Modeler, **Cost $ 1,123.00** One (1) copy of MGE Base Imager, **Cost $ 1,435.00**

Total package cost $ 22,371.00

CONSTRUCTION:

Hardware: One (1) TDZ40 High-end Workstation 133 MHz Dual Pentium processor. 32 MB of memory (expandable to 256 MB) and a 3.5-inch, 1 GB disk drive on a dual SCSI interface. An internal 5.25-inch, 600 MB, double speed CD-ROM drive, and 3.5-inch floppy disk drive, a three button mouse, and a personal workstation keyboard. **Cost $13,442.00**. One (1) 21-inch, 1.2 megapixel (1600x1200) color monitor. **Cost $1,763.00**

Software: One (1) copy of I/Basic Mapping for Windows/NT, which includes the following products: MGE/SX for Windows/NT, MGE Analyst, MGE Finisher, and

MGE Projection Manager. **Cost $4,608.00** One (1) copy MGE Terrain Modeler, **Cost $ 1,123.00** One (1) copy of MGE Base Imager, **Cost $ 1,435.00**

Total package cost $ 22,371.00

6. Hardware & Software Costs and Justification

6.1 Hardware Costs

Below is a summary cost break down of the more popular hardware configurations on the NAVFAC CAD-2 contract. For additional price information on scanners, memory, additional drives etc., please review the NAVFAC CAD-2 buyers guide for each respective vendor. The prices listed below may not be current at the time of order.

Intergraph		**CORDANT**	
TD-30	$ 6,092.00	SPARCstation 5 w/17" monitor	$ 6,597.00
TDZ40, 133	$ 7,800.00	SPARCstation 5 w/ 20" monitor	$ 9,320.00
TDZ40 Dual 133	$13,442.00	SPARCstation 20 w/20" monitor	$12,705.00
TDZ40 GLZ2	$14,567.00	SPARCstation 20/51 w/20" monitor	$13,739.00
TDZ40 GLZ6*	$20,567.00	SPARCstation 20/61 w/20" monitor	$16,684.00
17" Monitor	$ 900.00	Everex STEP w/17" monitor	$ 4,864.00
17" Monitor	$ 900.00	Everex STEP w/21" monitor	$ 6,503.00
21" Monitor	$ 1,763.00		
27" Monitor	$ 5,425.00		

All monitors listed above are color.

* Includes MOGEL

6.2 Software Costs

Below is a sample cost break down of the most popular software proposed in Section 6.1. Prices were quoted from the NAVFAC CAD-2 Buyers Guide. Prices may not be current when the implementation process is initiated. Please consult the Buyers Guide for the most current prices.

Intergraph	**CORDANT**
I/Basic Mapping for Windows/NT Includes: MGE, MGA, MGE Projection Manager, RIS, MGE Finisher $4,800.00	Basic Mapping Includes: ARC/INFO, ARC/INFO COGO $3,888.00

MGE/Basic Imager
$1,435.00
Grid,

MGE Modeler for NT
$1123.00

Advanced Mapping
Includes: ARC/INFO, ARC/INFO

ARC/INFO TIN

$1,296.00

Image Processing
ERDAS Imagine
$8,172.00

Digital Terrain Modeling
Civil DTM
$ 334.00

It should be noted that each vendor can configure various software/hardware packages to fit all the need of each Division with in the Savannah District.

6.3 Data Acquisition

This section discusses the acquisition of data for the proposed system. Sources and costs for each database will be listed as well as sources for optional data sets.

Data will be collected by each individual division, branch or section utilizing the GD&S. Data acquisition for a particular database may be coordinated and the expense shared by more than one group. It is recommended that groups which need to utilize the same database will actively share in the cost, acquisition and requirements of that particular database.

Data acquired by a user will be made available to all users in a central location. Acquired data may need to be converted to a generic or standard format before being archived so that it will be accessible by GD&S users on different platforms.

See Appendix D for information detailing the time and cost of data acquisition, database development and pilot projects. Milestones shall be established so that the timeline may be followed accurately and with performance evaluations.

Data to be collected and shared by Division:

	Real Estate	**Engineering**	**Planning**	**Operations**	**Emergency**	**Construction**
roads	x	x	x	x	x	x
parcels	x			x	x	x
vegetation					x	
wetlands	x	x	x	x	x	
coastline		x		x	x	x
topography	x	x	x	x	x	x
soils		x	x	x	x	x
demography	x				x	
geophysical		x	x			
hydrology		x	x	x	x	
hydrography	x	x		x	x	x
environ. sensitive	x	x	x	x	x	x
cultural data	x		x	x	x	
endangered species	x	x	x	x	x	x
USGS Quads	x	x	x	x	x	x
site boundaries	x	x	x	x	x	
building footprints	x				x	x
land cover				x	x	
land use		x	x	x	x	

Real Estate Division

Requires roads, parcel maps, vegetation, topography, wetlands, environmentally sensitive areas, cadastral.

Engineering Division

Requires roads, parcels, thematic information, topography, coastlines, roads, geophysical, environmentally sensitive areas, demographic information, core logs, hydrography and hydrology, survey points. Data is required both above and below ground.

PD Planning

Requires roads, parcels, thematic information, topography, coastlines, roads, geophysical, demographic

CD Construction Division

Requires site maps and A/E drawings. May need to use data from other groups.

EM Emergency Management Division

Requires roads, parcels, thematic information, topography, coastlines, roads, geophysical, demographic, hydrologic and hydrographic.

OP Operations

Requires roads, parcels, thematic information, topography, lake coastlines, roads, geophysical, demographic, County Soil Maps, NWI Maps, cultural data, endangered species data, USGS quads.

Digital data is available to the Corps from a variety of outside sources:

SEPCO- Savannah Electric and Power Company. Available includes local geodetic monuments, roads, utilities, aerial photography, cadastral parcel maps of city (1:2400 scale), etc. Projection is State Plane, GD&S format is AutoCad and ARC/INFO. Would like water and sewer data of Hunter Army Airfield in exchange.

Coastal Georgia- RDC (Regional Development Center) in Brunswick, Georgia TIGER road network 1:100k. Land cover/classification, NAP (National Aerial Photography Program) aerial photos (1993), airports, wells, etc. Works with local governments doing planning. Interested in data exchange for soils, wetlands.

USGS (United States Geological Survey) -DLGs (digital line graphs) 1:100,000 and DEMs (Digital Elevation Models) 1:25,000 of Georgia, South Carolina, and North Carolina are available on-line on the World Wide Web. See Appendix A.

SAGIS - Savannah Area GIS- A local GIS consortium made up of the utility company, Chatham County, City of Savannah, as well as other private and public agencies. They are setting common data format standards, as well as cost-sharing in GD&S database development. This group is very interested in SAS data exchange.

6.4 Database Development Costs

The geographical database will be designed based on the Tri-Service Spatial Data Standard as the guiding standard to define the parameters and format of all spatial

data collected and archived. The rational behind a single standard is not only the directive which states that the Tri-Service Standard must be used, but also the benefits derived from the use of a single standard are as follows: Users with differing GD&S systems and configurations will be able to import and export data into a common source, confident that a common schema is being used. Software bridges will be developed to translate data sources to and from various GD&S formats. Agreed upon design standards will increase the speed and improve the ease of data transfer. Costs of database development will be borne by individual users as well as cost-sharing in the case of commonly developed data. See Section 4.2 for more information on the Tri-Service Spatial Data Standard which is being adopted as much as possible as the data dictionary for the Savannah District implementation plan. Savannah District will in all likelihood modify the standards to meet end-user requirements. This effort will be coordinated with Tri-Services as well as other GD&S proficient Corps Districts (i.e. Fort Worth District).

6.5 Systems Benefits

6.5.1 Tangible Benefits

This section will discuss the benefits of using a GD&S over a manual method which may include the following issues: easier data entry, efficient data manipulation, credible data analysis, faster data output, improved access to current data, ability to perform complex analyses not possible with manual methods, and manpower savings.

A GD&S has many benefits over manual methods of spatial collection, manipulation, analysis and output. The advent of the modern computer and its associated systems has resulted in a powerful and cost effective tool for the automated processing and analysis of spatial data to create and display information needed to solve problems of a spatial nature. Manual methods of data collection are slow and laborious. A proficient keyboard operator may be able to enter data location points at the rate of several thousand per hour. However, an automated or even semi-automated system of data point collection in the field can store and process data as fast as it can be generated.

Manual methods of storing data are extremely slow and cumbersome when compared to GD&S. This is apparent with some systems currently in use in Savannah District. Files and boxes of hardcopy documents and maps required physical search and retrieval. On the other hand, an automated database on a GD&S allows almost instantaneous access. Furthermore, the data retrieval is custom fit to the user's exact requirements.

Data analysis of GD&S systems is more credible than manually calculated analysis because of the natural differences between people and machines. Human error can creep in as a result of fatigue, whereas a computer will never tire. Humans inevitably make mistakes. A computer, when given the proper instructions, will never err.

Statistical analysis of large data sets which take weeks by hand, require only seconds on today's "typical" machine.

The tangible benefits include:

1) Increase in productivity over manual methods.
2) Accuracy and speed improvement.
3) Large datasets can be quickly collected and processed.
4) Previously labor intensive operations which are prone to human error can be eliminated.
5) Long term costs savings will be realized.

See Appendix B for interview information of each listed division, branch or section.

Real Estate Division

RE-PC:
Real Estate Acquisition Branch will have tangible benefits from the implementation of the GD&S. Currently, hardcopy maps are utilized . The manual method of researching planning land acquisition and disposal is a long and arduous task. GD&S implementation will speed up the process of finding spatial information about a given area as well as its associated records. GD&S will benefit the RE-PC branch by allowing faster and more thorough integration of the spatial and non-spatial data layers such as parcels and their attributes needed in the real estate acquisition and disposal process. Maps currently being scanned in to a raster format need to be updatable. GD&S will integrate these scanned maps into a system which will allow electronic modification as needed.

RE-H:
The Homeowner Assistance Branch acquires and disposes of properties in areas where base closure has a significant (5%) effect on the real estate market. RE-HAP purchases the property from transferred personnel, and then resells it through licensed real estate brokers. Tangible benefits of GD&S for RE-HAP will be the ability to visually locate properties, map market conditions such as demographics and sales history, and then be able to identify where resources need to be allocate to help expedite the sales process.

RE-MT:
RE Forestry is charged with disposal of timber products. This is accomplished by surveying lands and accepting bids for the sale of timber and products in the survey parcels. GD&S will be of benefit by helping to more easily and accurately locate and map land parcels, estimate timber stands, etc. Integration of GPS points delineating sites, aerial photography, roads and environmental map bases will save time and money in receiving bids and delineating cut areas.

Engineering Division

EN-HA Hydraulics:
The Hydraulics Section of the District would benefit from GD&S by implementing an automated method to capture, update and display rainflow capture. The more timely and consistent collection of data will directly improve flood and dam pool analysis. More easily accessible and displayable data will improve flood and dam release level predictions.

EN-GH Hazardous, Toxic, and Radioactive Waste:
This Section is charged with clean-up of a wide range of sites of various sizes and types of contaminants. Most sites require sub-surface decontamination. Direct benefits from the implementation of GD&S will be the ability to integrate data such as topographic surveys, aerial photography, soil samples, groundwater and geophysical data into a GD&S for easier access, manipulation, analysis and graphic display. On-screen modification of MicroStation piping and instrument diagrams received from contractors will speed up the clean-up implementation process. Design of future diagrams will be speeded by accessing previously designed similar site diagrams. GD&S capability to do 3D modeling will also be very useful in the management of waste sites.

EN- GG Geotechnical:
The Geology and Hydrogeology section of SAS performs subsurface exploration for Savannah District, including rock coring, well and groundwater studies and geophysical logging. GD&S benefits for this section would be to build a dataset of study areas so that interactive querying and analysis could be performed. A method to directly download sensor data from the field into the GD&S would be beneficial to the exploration process.

EN-DG Site Development & Civil Engineering:
Site Development & Civil Engineering Section is responsible for overseeing the design and decision-making process of civil and military work throughout the district. GD&S benefits for this section will be the creation of database of master plans of bases, including roads, facilities, environmental data and especially a library of bore logs. Efficiency in the decision-making process will be improved by allowing easier access to information now scattered in various formats and locations. Overall time in designing a project will be improved, and more thorough search and analysis will be realized by linking together the desire project elements into a spatial database.

EN-EC Spatial Engineering:
This Section currently has a well developed stand-alone GD&S capability. Advantages to this section will be the creation of a central database in which desired spatial data can be stored and maintained. Current GIS project work can be linked to the central server to download data as needed by the various groups. Benefits to this section will be that the increase in use of GD&S will improve productivity of the

District overall. As SAS becomes more proficient in GD&S, the Spatial Engineering Section will be able to accomplish its goals easier of disseminating spatial data for District project work.

EN-HS Survey and Hydrography

This Section performs surveys for all groups of the District, including land or property surveys and the establishment of harbor lines. It does both military and civil projects, including dams, earthworks and construction surveys. Both pre- and post-construction surveying is performed. The creation of a library of survey monuments would reduce the collection of redundant data and increase the efficiency of the Section by allowing for quick and accurate look-up and display of geodetic monuments that need to be used as control points in the surveying process. A GD&S site map, capable of locating and displaying geodetic monuments for field crews, would replace the current manual method of searching hardcopy output to locate surveying monuments.

PD Planning Division

Planning Division will benefit from GD&S by being able to update existing spatial data projects and to create new ones from scanned drawings. Current data formats are from various vendors, A long term benefit would be the increase in analysis capability by incorporating cultural and thematic data into existing data for detailed GD&S analysis.

CD Construction Division

Construction Division is responsible for the actual construction of projects, which includes contracting work out to private vendors. Benefits of GD&S to the Division would the capability to have a CADD system to let management and users more easily share data before and during the construction process. On-site capability to interact with the construction drawings during the construction process would result in finished “as-built” plans when the project completed, not months or years later. These plans will form a value base for facilities management, saving time and effort in the long run.

EM Emergency Management Division

This Division is responsible for both man-made and natural disaster emergency activities in the Savannah District. GD&S would be of great benefit to this Division by providing timely and easily updateable information relevant to disaster planning and emergency reaction. Of particular interest, GD&S would be useful to predict storm surges. Also, emergency scenario querying and analysis would be beneficial to developing emergency reaction plans. The current PC mapping system is useful, but limited in its capability of receiving and updating information.

OP Operations Division

OP-RL:
The Russell Lake site will benefit from GD&S by analyzing spatial thematic information about their area of interest. The ability to do collection, analysis and interpretation of data on-site will be cost-effective in the process of planning, development and operation of Russell Lake. Long term capability to monitor the lake area using GD&S will improve efficiency in gathering and analyzing lake area data.

OP-FA:
Operations will benefit by having an interactive system capable of accessing an electronic database of project area for permit actions, past impacts, known resources, etc. It will increase efficiency of calculating resources by watershed and county. A common orthophoto base map of the District study areas will improve the speed of decision making process.

6.5.2 Intangible Benefits

Intangible benefits of using a GD&S include the following:

1) Extended use/reuse of mapping data.
2) Ability to analyze more alternatives.
3) Common framework for analysis and data sharing.
4) Credibility and repeatability of analysis.
5) Interdependence of organizations, modeling, morale and prestige.

While many benefits of GD&S implementation can be quantitized, they are also less easily measured, but still, there are very real benefits to be gained from the implementation of GD&S. A GD&S is dynamic; its data can be used over and over, and is easily updatable. Consider the comparison between manual cartographic output and the dynamic nature of electronic data layers stored in a GD&S. A manually-created map must be redrawn each time that any element of it is going to be changed. The dynamic nature of the electronic map means that it can be used over and over, indefinitely. GD&S allows for many alternatives to be easily and quickly explored. A user can manipulate the database in seconds and receive instant graphical output. If the results are not acceptable, new parameters can quickly be established and the scenario re-run. Since the analysis is based on concrete, logical formulas, the results can be repeated over and over. Another major benefit is the ability to share the database between many users. Sharing data results in cost-sharing and allows individual users access to much more data than they would otherwise be able to afford on their own.

Intangible benefits include the ability to reuse data for other projects eliminating the necessity to collect it again. Many more types of analyses can be performed and more quickly, thus both improving and speeding up the analysis process. Additionally, a

uniform database will ease data access and increase its utility. Analyses will be more reliable and accurate, thus facilitating a better outcome. These results are not directly measurable, yet they a very real benefit of implementing a GD&S.

Overall, the intangible benefits for each Division, Section and Branch will be the savings of sharing a centrally organized and updated database. Several groups sharing commonly needed data will directly and indirectly benefit each other. The overall effect of implementing a GD&S at the Savannah District will be the improvement in efficiency through the sharing of common resources.

7. System Implementation

7.1 Personnel Requirements and Costs

The staffing requirements of the GD&S will be dependent on the particular group and the level of GD&S implementation. One of the overall goals of the District's plan is to integrate GD&S as much as possible into the current workflow. GD&S will be both a tool and a guide in performing and managing the workflow process. Present staff will need to be trained in how to effectively utilize the GD&S. Staffing to oversee the District plan, including the management and maintenance of the central database will require dedicated staff with expertise in GD&S. The individual users will not be GD&S experts, but rather will be trained to a level which will allow them to increase their productivity by using a GD&S.

Each group implementing GD&S should assign responsibility of that group's system to a knowledgeable user. This designated person shall be the point of contact and channel of information between the contractor, spatial database manager, and his or her group.

The basis for GD&S personnel in an individual group will vary with the current level of expertise and experience available. Many groups already have CADD expertise, which will form the foundation of training for GD&S personnel. The specific needs of a group will determine the number and level of expertise required to staff the GD&S within that group.

The shared database will be maintained centrally by assigned personnel, with the various data components supplied the responsibility of individual groups and their staff.

7.2 Training Requirements and Costs

Acquiring and developing skilled personnel for the operation and maintenance of the GD&S is an extremely important task. The GD&S industry is growing both in number and in technology, so there will be a continuing need for advanced training. GD&S education can be pursued through contractor seminars/classes or through

college course work. Having highly-skilled staff must be a high priority in order to maintain a complicated system such as a GD&S. The best designed and implemented GD&S is useless without well-trained and conscientious personnel. Training is very important to the success of the GD&S. As with most technical fields, GD&S is constantly changing and improving. As a result, not only is initial training necessary at the start of the GD&S, but the GD&S technician must keep abreast of what is happening in the field.

The training program for the implementation of the GD&S will be provided for in part by the vendor of the hardware and software components of the GD&S. By using the NAVFAC CAD-2 contract, additional training can be purchased to learn existing systems. This will be used to maintain a highly-skilled and educated staff. Multiple disciplines must be supported to ensure that a properly prepared staff is available. This may include scheduling contractor-based or college course-based GD&S dedicated seminars.

A comprehensive training course will be developed to meet the training needs of each individual user, with formal training and on-going on-site informal training as needed.

Basic CADD and GIS training will be held either on-site or at another location depending on the needs of personnel to learn the particular system of GD&S which will be installed in their Division.

TRAINING REQUIREMENTS BY GROUP:(PER PERSON COST)

	Windows NT	MicroStation	MGE	MGE-A	MGE Imager	MGE Modeler	MGE Finisher	MGE Project.	TOTAL
Cost	$ 180.00	$ 720.00	$ 900.00	$ 360.00	$ 540.00	$ 540.00	$ 540.00	$ 360.00	
RE-PC	1	1	1	1	1			1	$ 3,060.00
OP-FA									-
OP-RL									-
OP DIV	1	1	1	1	1			1	$ 3,060.00
EM DIV	1	1	1	1	1			1	$ 3,060.00
CD	1	1	1	1	1			1	$ 3,060.00
PD	1	1	1	1	1			1	$ 3,060.00
EN-HS	1	1							$ 900.00
EN-EC	1	1	1	1	1	1	1	1	$ 4,140.00
EN-DG	1	1							$ 900.00
EN- GG	1	1	1	1	1			1	$ 3,060.00
EN-GH	1	1							$ 900.00
EN-HA	1	1	1	1	1			1	$ 3,060.00
RE-MT	1	1							$ 900.00
RE-H	1	1							$ 900.00
ON-SITE*	$ 536.00	$ 2,144.00	$ 2,680.00	$ 1,072.00	$ 1,608.00	$ 1,608.00	$ 1,608.00	$ 1,072.00	$ 12,328.00

No formal training course exist for VISTA MAP. Training will be furnished by EN-EC

	MicroStation**	ArcInfo	ArcInfoGrid	ArcInfo COGO/TIN	Arcview	Arcview Avenue	
Cost	$ 720.00	$ 108.00	$ 108.00	$ 83.00	N/A	N/A	
RE-PC							-
OP-FA	1	1	1	1	1	1	$ 1,019.00
OP-RL	1	1	1	1	1	1	$ 1,019.00
OP DIV							-
EM DIV		1	1	1	1		$ 299.00
CD							-
PD							-
EN-HS							-
EN-EC		1	1	1	1	1	$ 299.00
EN-DG							-
EN- GG							-
EN-GH							-
EN-HA		1	1	1	1		$ 299.00
RE-MT							-
RE-H							-
ON-SITE*	$ 2,144.00	$ 1,377.00	$ 1,377.00	$ 849.00	N/A	N/A	$ 4,898.00

* ON-SITE TRAINING DOES NOT INCLUDE TRAVEL COST.
** MICROSTATION WILL BE USED AS THE CAD ENGINE. AUTOCAD WILL NOT BE NECESSARY.

7.3 Acquisition Strategy

It is anticipated that some funding for the implementation will come out of District overhead. The major funding sources will be the individual Divisions, Branches and Sections of SAS which will be using the GD&S. The cost of database development will be shared in proportion to the anticipated need of that data. For example, virtually every group involved will require a digital road base layer for regional, state and local areas. Accordingly, if ten groups have a need for such data, then the cost can be divided among the ten groups. If one group has a high use requirement for a particular data set, while another group has a low use need, the high use group will bear a proportionally large burden in funding the data set acquisition. The overall cost for that group will still be lower since other groups will share in the cost, as compared with one group funding a particular data set entirely with its own resources.

Another possible avenue of funding for GD&S projects associated with water resources is a Federal program called Section 22, a Planning Assistance Program to the States for Water Resources. This cost-sharing program funds a portion local projects involving hydrography, flooding, water supply, recreation, etc.

Funding for hardware and maintenance of a shared data server will follow a similar scheme. Workstations or PCs used exclusively by a group will be funded by the group. Shared hardware/software and data will be acquired and maintained through cost-sharing.

The responsibility for set up, training, and database development will be with the Spatial Engineering Section and contractor.

7.4.1 Mission Assignments

Operations Division: Richard B. Russell Lake OP-RL

Directs on-site planning, development, and operation of the Richard B. Russell Lake. Inspects earthen dams and participates in remedial actions in case of an emergency involving dam safety.

Operations Division: Regulatory Branch OP-PA

Administers and enforces various federal laws regulating structures, dredging, and deposition of materials and related work in the "Waters of the United States" which include all navigable waters and their tributaries, and any wetlands, either adjacent to or far from navigable waters. Maintains navigation as well as the chemical, physical, and biological integrity of the Savannah District’s waters.

Construction Division: CD

Handles all aspects of project construction contracting in the Savannah District, including bidding and on-site supervision of construction sites.

Emergency Management Division: EM

Responsible for Savannah District natural and manmade emergency activities such as floods, tornadoes, storms, hurricanes, and manmade disasters, including activities of the Savannah District Corps of Engineers, CESAD, HQUSACE, DA, FEMA, and other Federal and State agencies. EM responds to natural and man-made disasters. For example, hazardous materials spills, floods, hurricanes, tornadoes, etc. Covers about half of Georgia, over 100 counties, primarily east of I-75. Works with state and federal agencies, such as FEMA.

Engineering Division: EN

Exercises supervision in planning, directing, coordinating, and executing the entire civil and military engineering programs of the Savannah District, beginning with foundation exploration and analysis, surveys and on through design and preparation of final construction plans, specifications, invitations to bid, and technical support during construction. Identifies, implements, and evaluates computer automated applications for engineering design and management.

Coastal and Waterways Engineering Section: EN-HC

Mission: Performs hydraulic design of coastal, shore and harbor protective structures, river training works, navigation channels, and other civil works projects. Manages routine maintenance dredging of Savannah and Brunswick Harbors, the Atlantic Intracoastal Waterway, and the Savannah River Below Augusta navigation projects. Conducts studies of coastal phenomena involving natural movement and disposition of sediments in estuaries, and conducts studies of effects of navigation channel on littoral drift and periodic shoreline and beach profile changes along coastal areas of the District. Coordinates and documents beach profile monitoring programs established in consequence of beach erosion control studies and projects.

Performs storm surge height studies, establishes flood height frequency relationships, and develops other information required by Flood Plain Management Services Branch, Planning Division, for use in preparation of Coastal Flood Plain Information Reports, Coastal Flood Hazard Reports, and Coastal Flood Insurance Reports.

Engineering Division: Hydraulics Section EN-HA

Provides hydrologic engineering and hydraulic design support to all elements of the District.

Provides all hydrologic and hydraulic engineering studies for surveys and interim reports, feasibility studies, flood plain management and insurance studies, and authorized projects. Prepares Reservoir Regulation Manuals; Drought Contingency Plans; and hydrology and hydraulic memoranda for design of navigation, multipurpose and flood control projects

Performs flood routings and makes lake elevation and river stage forecasts; coordinates and supervises lake operation during flood periods. Develops District's dam operations management policy and assists in developing evacuation plans downstream of Corps dams.

Conducts water quality control sampling and analysis activities at Corps projects. Prepares storm studies to derive discharge capacities required for spillways, channels, spilling basins, drainage structures, bridge openings, floodways, culverts, and flood hazard studies; develops streamflow profiles, velocities, and discharges for channel stabilization and maintenance of inland water project. Performs hydraulic design for dams, navigation locks, channels, and other civil works projects. Reviews structures and channels designed by other elements to assure that required discharge capacities and hydraulic characteristics have been provided.

Engineering Division: Coastal and Waterways Engineering Section EN-HC

Performs hydraulic design of coastal, shore and harbor protective structures, river training works, navigation channels, and other civil works projects. Reviews structures designed by other elements to assure that required hydraulic characteristics have been provided.

Manages routine maintenance dredging of Savannah and Brunswick Harbors, the Atlantic Intracoastal Waterway, and the Savannah River Below Augusta navigation projects. Coordinates with Project Operations Branch, Operations Division, the scope of work for dredging; prepares hired labor cost estimates for engineering and design activities; coordinates and schedules design, typing, reproduction, and procurement activities with appropriate technical and support elements to prepare contract plans and specifications and advertise the work.

Performs storm surge height studies, establishes flood height frequency relationships, and develops other information required by Flood Plain Management Services Branch, Planning Division, for use in preparation of Coastal Flood Plain Information Reports, Coastal Flood Hazard Reports, and Coastal Flood Insurance Reports

Engineering Division: Survey and Hydrography Section EN-HS

Performs hydrographic and topographic surveys, lays out horizontal and vertical control nets, establishes latitude and longitude, makes land or property surveys and establishes harbor lines. Administers contract surveys and contract mapping involving photogrammetric techniques.

Planning Division: Budget and Information Management Unit PD

Develops annual budget and supporting data for all programs managed by Planning Division. Monitors Planning Division's civil and military resources.

Prepares State Water Resources Development Book and coordinates Planning Division input to special meetings and reports.

Provides Planning Division report preparation assistance. Support may include collecting or analyzing technical data, such as budgetary and manpower information.

Manages CADD and microcomputer systems. Provides CADD support in Civil and Military master planning and in preparation of maps, fact sheets, and brochures.

Administers the Special Investigations and Intra-agency Water Resources Development programs of Planning Division. Assists in making public meeting arrangements and keeps mailing list current for public involvement programs.

Coordinates and monitors Planning Division training program.

Coordinates information management needs.

Engineering Division: Hazardous, Toxic, and Radioactive Waste Section EN-GH

(1) Coordinates and executes all Engineering Division work related to hazardous, toxic, and radioactive waste (HTRW) planning, design, and construction activities. Plans and executes design studies related to ground water and soil contamination; assessment; and remediation studies undertaken to meet environmental regulations of federal, state, or local governments.

Engineering Division: Geology and Hydrogeology Section EN-GG

Formulates and directs field investigations and surface and subsurface geological exploration programs for civil, military, and HTRW programs. Evaluates and assesses geologic conditions and prepares geologic portions of design memorandums, plans, specifications, foundation reports, and HTRW reports.

Conducts sampling and field tests and analyzes hydrogeologic data and prepares reports in support of miscellaneous studies, such as landfill siting, salinity infiltration studies, and soil and ground-water contamination on HTRW sites.

(1) Engineering Management Unit. EN-EM

Recommends method of execution (in-house or A-E) for the civil and military engineering program for the Savannah District. Final determinations are to be mutually agreed upon by EN and PM. Provides assessments on internal design capability, workload distribution, and manpower requirements necessary to meet mission requirements, including recommendations for contracting capability to supplement in-house design expertise, manages and coordinates all in-house design and A-E support activities within Engineering Division.

Budgets, schedules, assigns, and tracks all commitments for technical work assigned within Engineering Division. Develops, operates, and maintains systems and procedures for providing routine reports to Chief, Engineering Division on in-house design costs, design percentages, manpower distribution and utilization, technical capability, and project (tasks) schedules and for monitoring project costs, schedules, and internal coordination. Provides technical assistance for the identification and/or resolution of construction problems.

Engineering Division: Spatial Engineering Section EN-EC

Formulates plans, policies, and procedures for Computer Aided Drawing and Design (CADD), Automated Mapping and Facility Management (AM/FM), Cyclic Maintenance (CM), and Geographical Information Systems (GIS) projects and/or activities. Provides technical guidance and support for automation as related to CADD, AM/FM, CM, and GIS. Participates in the development of all scopes of work for projects and/or contracts relating to CADD, AM/FM, CM, and GIS. Coordinates CADD, AM/FM, CM, and GIS

master plan for hardware and software acquisition, allocations and procurement with Information Management Office. Coordinates with users and Information Management on the preparation of equipment and software specifications.

Acts as customer advocate and serves as point of contact when military installations require CADD, AM/FM, CM, and GIS support or services which are not routinely provided by the various District organizations. Establishes, maintains, and archives CADD electronic files. Coordinates with Information Management to assure procedures are followed. Initiates action for appropriate reproduction after contract award to the successful bidder. Establishes and advertises contract(s) for supplementary contract drafting services.

Engineering Division: <u>Site Development & Civil Engineering Section</u> EN-DG

(1) Responsible for the site development and environmental portions of design for civil and military work throughout the District- roads, water, sewer, sanitary systems, storm drains, landscape design. Ninety percent of the projects done are military.

7.4.2 Milestones

This section defines short-term and long-term milestones so that evaluations can be performed and progress can be reviewed regularly.

Overall milestones for the plan include:

- conducting of a detailed day to day workflow for each participating group
- establishing a central data server
- delivering and setting up the system
- personnel training
- establishing procedures for database creation/maintenance.

Goals for each group are the accomplishing each given group's mission. Milestones are the objectives required to reach the goal.

In order to properly service the given group, the following milestones must be accomplished:

1) Evaluate: Site survey of group's workflow, data input/output, evaluate system inventory, personnel GD&S level (2 weeks min)

2) Present findings: Make presentation and receive feedback at follow-up meeting. Refine plan.(1 week)

3) Design: Design an implementation plan (2 weeks)

4) Present formal plan: presentation of the implementation plan(2 days)

5) Modify plan: Make modifications to implementation plan based on feed back (1 week)

6) Schedule: Schedule accepted implementation (resource allocation) (1 week)

7) Training and hardware and software delivery

8) Implementation (time will vary according to accepted plan)

9) Periodic review as dictated by accepted plan

10) Implementation completion

11) Plan Assessment

7.4.3 Document Lessons Learned

Daily logs of GD&S use by each group during the initial implementation will be recorded to document problems and solutions encountered during the implementation phase. Such items to be included in the logs include:

- Hardware problems and solutions.
- Network and database access procedures and problem solutions.
- Data format and acquisition problems and solutions.
- Data conversion difficulties.
- Creation and maintenance of shared spatial databases.
- Any other information which will be beneficial to using the GD&S.

These logs will form the basis for a document of "Lessons Learned" which will aid in the creation of procedures and practices needed to maintain the GD&S as well as train staff in its proper use and maintenance.

8. Evaluation Plan

8.1 Geospatial Data and Systems Technical Committee

Each group responsible for GD&S will have a representative on the Geospatial Data Technical Committee. The representative should be a high-level system-knowledgeable user and be capable of making technical decisions for the Section represented. The Committee will report to the Executive Information Steering

Committee (EISC) on a quarterly basis or at major project milestones. The Committee will make recommendations for projects and determine required funding. The EISC will have the responsibility for approving the recommendations.

8.2 Time Table

The Geospatial Data Technical Committee will report to the EISC Committee the status of the District GD&S system and its implementation. The group will meet quarterly and at other times as required by major achievements or milestones of projects.

9. Conclusions and Recommendations

The research for the IP has indicated, as we suspected, Savannah District has many applications which come under the heading of Geospatial Data and Systems (GD&S). The actual implementation has only occurred for our Military customers as supported by EN-EC. Generally each division has some knowledge of GD&S and the advantages of having a system. However, little knowledge is apparent in the use of the tools or software required to implement a system. Based on the current condition the following recommendations are made to successfully move Savannah District into the GD&S arena.

A. Any GD&S data unless officially restricted will reside on a GD&S server. Thus, the information will be shared by all GD&S participants. The responsibility of backups and archiving will reside in EN-EC with the CADD system administrator. Each GD&S project should have a single manager responsible for directing EN-EC to archive at significant milestones.

B. Initially all updates should be the responsibility of Engineering Division at the direction of the proponent of each division or section participating in the development of the system. As training progresses within the divisions this responsibility will be shifted to a team member or members within the division. With proper training this time could be as soon as six months.

C. Each Division or participating office will require a detailed implementation plan specific to their requirement. This plan will address, in detail, schedules, hardware/software, data responsibility , data accuracy and cost. Each plan will be required to be compatible with the District system.

D. The CAD engine for GD&S systems will be MicroStation. The primary GIS software will be the MGE suite from Intergraph using Intergraph hardware. arc/info systems on SunSparc Stations will also be in place at the lakes and Emergency Management. Emergency Management will need to have expertise available on both platforms because of the wide variance in data sources needed for emergency operations.

E. A wide range of data sources exist from Defense Mapping Agency, to USGS, to the Coastal Regional Development Center (CRDC) to SAGIS, the local consortium consisting of the County, City of Savannah, Savannah Electric and Power Company and as a new member the Corps of Engineers. The most useful information will come from SAGIS and possibly CRDC. However, we will have to furnish information to them such as wetland information in order to use their data.

F. The GD&S for Savannah District will adhere to the Tri-Services Spatial Data Standard as much as possible. However, initial review of the standards has indicated that changes are required to make the standard useful to Savannah District and its customers. Each GD&S participant should have communication with their counter parts in other SAD districts and GIS proficient districts such as Forth Worth District. This will help assure efficient use of existing technology and data and at the same time cause us to sound as one voice to Tri-Services in the development of standards.

G. The use of TCP/IP and access to the Internet is essential to each GD&S participant. The TCP/IP is accepted as the industry standard and the Internet provides a vast resource of data for GD&S.

H. A six month pilot project is recommended with at least one participant from each Division. The pilot project will address sharing of data, data accuracy, transfer of data between platforms, and required future funding.

I. Each participating group will have a representative on the Geospatial Data Technical Committee. This committee will serve as the steering committee for GD&S development and will make recommendations to the Executive Information Steering EISC for approval.

J. The issue of Metadata should be addressed through a trial implementation of at least two civil projects with detail documentation as to time required and problems encountered. Whereas, the District agrees in concept with the idea of metadata, it appears that the requirement, as it exists, is far too cumbersome and will not be useful. The trial implementation should address the data required to best meet our requirement.